National Institute of Environmental Health Sciences

Trends in global warming and human health impacts related to Brazilian sugarcane ethanol production considering black carbon emissions

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Abstract:

Sugarcane produced in Brazil has several environmental advantages. However, burning residues, which leads to GHG and black carbon (BC) emissions, has been used to facilitate manual harvest. BC emissions have a net warming effect and cause health problems. Mechanized harvest without burning is gradually replacing manually harvested burned sugarcane. Global warming potential (GWP) and human health indicators of sugarcane ethanol production in Brazil, in the pre-mechanization (100% burned), current (similar to 50% burned) and future (100% without burning) scenarios, were calculated. In the past, the GWP of ethanol production was 1.1 kg CO2 eq L-1 and BC emissions were 32.6 kg CO2 eq L-1. The human health impact in disability adjusted life years (DALY) was 3.16E-05 DALY L-1 ethanol. The current ethanol production process has a GWP 46% smaller, while BC emissions are seven times smaller than before mechanization started. The human health impact is currently 7.72E-06 DALY L-1. In the future, with complete mechanization and the integration of first and second generation ethanol, the expected GWP emissions will be 70% smaller, and BC emissions will be 216 times smaller than when all sugarcane was harvested with burning. These results show that ethanol production in Brazil is improving in terms of global warming and human health aspects. Other upstream aspects of ethanol production such as direct and indirect land use change, and downstream impacts such as the emissions of acetaldehydes were not considered in this study, which focused on a major technological shift in residue management in the agricultural phase of sugarcane ethanol production. A broader assessment of the sustainability of ethanol must account for those issues, as well as economic and social aspects. Sugarcane-derived ethanol produced in Brazil has been considered one of the most sustainable biofuels options, but it is essential to identify and promote practices and policies that further improve its production, such as the phase out of pre-harvest sugarcane burning and the increase in ethanol yield per unit of area.

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Resource Description

Climate Scenario :

specification of climate scenario (set of assumptions about future states related to climate)

Other Climate Scenario

Other Climate Scenario: pre-mechanization (100% burned), current (50% burned) and future (100% without burning) scenarios of sugar cane harvesting

Exposure :

weather or climate related pathway by which climate change affects health

Air Pollution, Unspecified Exposure

Air Pollution: Particulate Matter

Geographic Feature:

resource focuses on specific type of geography

Rural

Geographic Location:

resource focuses on specific location

Non-United States

Non-United States: Central/South America

Health Impact:

specification of health effect or disease related to climate change exposure

Cancer, Morbidity/Mortality, Respiratory Effect

Respiratory Effect: Other Respiratory Effect

Mitigation/Adaptation:

mitigation or adaptation strategy is a focus of resource

Mitigation

Model/Methodology:

type of model used or methodology development is a focus of resource

Exposure Change Prediction, Outcome Change Prediction

Resource Type:

format or standard characteristic of resource

Research Article

Timescale:

time period studied

Medium-Term (10-50 years)